

Human capital, structural capital, and relational capital: effects on firm performance in Indonesian manufacturing companies (2023–2024)

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Abstract

This study examines the effect of human capital, structural capital, and relational capital on firm performance in manufacturing companies listed on the Indonesia Stock Exchange (IDX) during the 2023–2024 period. A quantitative approach was applied using multiple linear regression analysis. Using purposive sampling, 70 companies were selected, yielding 140 firm-year observations. The independent variables, human capital, structural capital, and relational capital, were measured using the Modified Value Added Intellectual Coefficient (M-VAIC) approach, while the dependent variable, firm performance, was proxied by Return on Assets (ROA). The results show that human capital has no significant effect on firm performance ($t = 0.551$, $p = 0.583$), whereas structural capital ($t = 2.337$, $p = 0.021$) and relational capital ($t = 2.675$, $p = 0.008$) have a positive and significant effect. The three variables jointly explain 9.5% of the variation in ROA (Adjusted $R^2 = 0.076$; $F = 4.786$, $p = 0.003$). The findings support Resource-Based Theory by showing that internally developed systems and externally oriented stakeholder relationships are, in this sample and period, more consistently associated with financial performance than human capital alone. Companies are advised to strengthen structural and relational capital as strategic resources while continuing to invest in human capital development to support long-term, sustainable performance.

Keywords: firm performance, human capital, relational capital, structural capital

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Introduction

The rapid development of the global economy has encouraged companies to continuously improve their competitiveness in order to survive and grow in an increasingly dynamic business environment. In the past, corporate success was largely determined by the ownership of physical and financial resources. However, in the current knowledge-based economy, companies are required to utilize intangible resources that can create additional value and support sustainable business growth. One of the most important intangible resources is intellectual capital, which consists of human capital, structural capital, and relational capital.

The manufacturing sector is one of the major contributors to economic development and plays an important role in supporting industrial growth. Manufacturing companies face various challenges, including intense market competition, technological advancement, changing consumer preferences, and increasing demands for operational efficiency. As a result, companies are expected not only to maximize production capacity but also to strengthen the quality of their internal resources and business relationships in order to achieve better performance.

Human capital reflects the knowledge, skills, competencies, and experience possessed by employees in carrying out organizational activities. Employees with high capabilities can contribute to innovation, improve productivity, and help companies adapt to changes in the business environment. At the same time, structural capital supports organizational performance through effective systems, procedures, databases, technologies, and management processes that enable knowledge to be utilized efficiently throughout the company. In addition, relational capital represents the relationships established between the company and external stakeholders, including customers, suppliers, investors, and business partners. Strong relationships with these parties can support business continuity, expand market opportunities, and strengthen corporate competitiveness.

This study is based on Resource-Based Theory (RBT), which explains that company performance is influenced by the ability to manage strategic resources effectively. Resources that possess unique characteristics and are difficult for competitors to imitate can become a source of sustainable competitive advantage (Barney and Clark, 2007). In this context, human capital, structural

capital, and relational capital are considered strategic resources because they contribute to value creation and support the achievement of organizational goals (Barney, 1991; Bontis, 1998).

Empirical evidence on the intellectual capital–performance relationship remains mixed, and the specific pattern of significance varies across sectors, periods, and measurement approaches. For human capital, Asutay and Ubaidillah (2024) found a positive and significant effect on performance in Islamic banks, whereas Ali et al. (2022), in a cross-country comparative study, and Indriyana and Munawaroh (2024), in Indonesian manufacturing firms, both reported that human capital does not always translate into significantly higher financial performance, in contrast to Farhanah and Susilawati (2022), who found a significant positive effect in a different sample of Indonesian firms. For structural capital, Skhvediani et al. (2023), studying Russian manufacturing companies, and Indriyana and Munawaroh (2024) both reported significant positive effects, while evidence on relational capital is comparatively more consistent: Fuad and Nustini (2022) in Indonesian pharmaceutical firms and Besir and Yuyetta (2023) in Indonesian banking firms both found positive and significant effects, though these studies are concentrated in non-manufacturing sectors. This pattern suggests that findings for human capital in particular are sensitive to sector and context, while manufacturing-specific evidence combining all three components within a single, recent model remains limited.

This gap is particularly relevant for Indonesian manufacturing companies, which rely simultaneously on tangible production assets and intangible organizational and relational resources, and for which post-pandemic operating conditions during 2023–2024, the most recent period for which complete annual and financial report data are available, have not yet been examined using a combined M-VAIC-based model. Accordingly, this study aims to examine the influence of human capital, structural capital, and relational capital on the performance of manufacturing companies listed on the Indonesia Stock Exchange during this period. The study contributes to the intellectual capital literature by testing all three M-VAIC components jointly in a single-sector, recent-period Indonesian setting, offering evidence on which components of intellectual capital

manufacturing firms should prioritize when the components are evaluated together rather than in isolation.

The remainder of this paper is organized as follows. Section 2 reviews the relevant literature and develops the research hypotheses. Section 3 describes the research method, including sample selection, variable measurement, and the data analysis technique. Section 4 presents the results and discussion. Section 5 concludes the study and outlines its theoretical and practical implications, limitations, and directions for future research.

Literature review

Human Capital and Firm Performance

Human capital is one of the main components of intellectual capital and represents the knowledge, skills, competencies, experience, and innovative capabilities possessed by employees. Human capital is considered a strategic intangible asset because it contributes directly to value creation and organizational performance. According to Bontis (1998), human capital reflects the collective capabilities of employees that enable firms to achieve competitive advantage.

From the perspective of Resource-Based Theory, human capital is viewed as a valuable and difficult-to-imitate resource that can improve productivity, innovation, and profitability. Empirical evidence is nonetheless mixed: Asutay and Ubaidillah (2024) found that human capital has a positive and significant effect on firm performance in Islamic banks, indicating that effective management of employee competencies can contribute to higher organizational efficiency and profitability. In contrast, Ali et al. (2022) and Indriyana and Munawaroh (2024) reported that human capital does not always have a significant effect on firm performance, suggesting that its financial payoff may depend on how consistently competencies are translated into operational outcomes and on the length of the observation period, since returns on human-capital investment often materialize with a lag. Guided primarily by the theoretical expectation under RBT, this study proposes:

H1: Human Capital has a positive and significant effect on Firm Performance.

Structural Capital and Firm Performance

Structural capital is a component of intellectual capital that consists of organizational systems, procedures, databases, technologies, routines, and corporate culture that support business operations. Structural capital remains within the organization even when employees leave, making it an important organizational asset. According to Vale et al. (2021), structural capital facilitates the transformation of individual knowledge into organizational knowledge that can be utilized continuously to support value creation.

Within the Resource-Based Theory framework, structural capital is regarded as a strategic resource that enhances operational efficiency, knowledge integration, and organizational effectiveness. Research by Skhvediani et al. (2023) on Russian manufacturing companies and Indriyana and Munawaroh (2024) on Indonesian manufacturing firms both found that structural capital positively and significantly affects firm performance, suggesting that effective organizational systems and processes contribute to improved profitability. Although evidence specifically contradicting this relationship is scarcer in the manufacturing literature than for human capital, the strength of the association may still vary with the maturity of a firm's information systems and internal controls. Based on the weight of prior evidence, this study proposes:

H2: Structural Capital has a positive and significant effect on Firm Performance.

Relational Capital and Firm Performance

Relational Capital is an important component of intellectual capital that reflects the quality of relationships between a company and its external stakeholders, including customers, suppliers, investors, regulators, and business partners. Strong relational capital is developed through trust, reputation, collaboration, and long-term commitment. According to Thaib et al. (2022), relational capital plays a vital role in strengthening business networks and supporting sustainable value creation.

From the Resource-Based Theory perspective, relational capital represents a valuable and difficult-to-replicate resource that can strengthen a firm's competitive position and improve market performance. Because relational capital is, by definition, oriented toward external stakeholders rather than internal firm

resources, its theoretical grounding is further reinforced by a stakeholder-oriented view: strong external relationships reduce information asymmetry and transaction costs with customers, suppliers, and investors, which RBT alone, with its emphasis on internal resource control, does not fully capture (Freeman, 1994). Empirical studies by Fuad and Nustini (2022) found that relational capital contributes positively to firm performance through the enhancement of stakeholder trust and corporate value creation. Similarly, Besir and Yuyetta (2023) reported that relational capital has a positive and significant effect on financial performance. Based on this combined theoretical and empirical support, this study proposes:

H3: Relational Capital has a positive and significant effect on Firm Performance.

Conceptual framework

Figure 1 summarizes the three hypothesized relationships tested in this study. Human capital, structural capital, and relational capital are modeled as independent variables predicting firm performance, proxied by ROA, consistent with the M-VAIC-based regression model specified in Section 3.

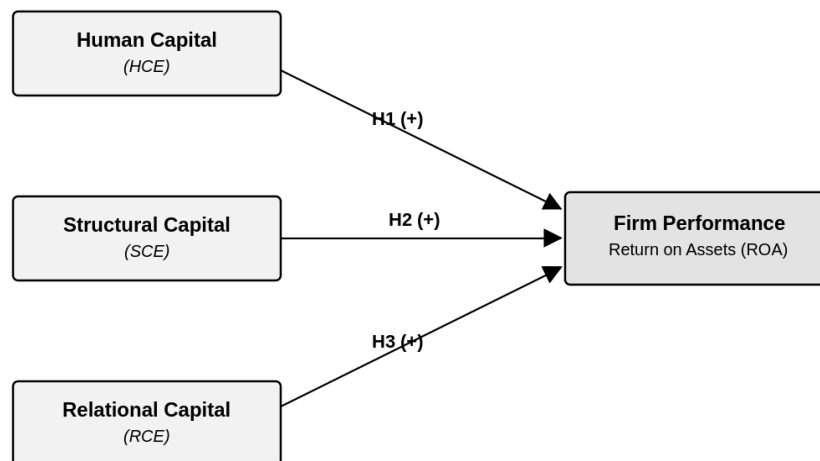


Figure 1. Conceptual framework

Research method

This study applies a quantitative approach using secondary data obtained from the annual reports and financial statements of manufacturing companies listed on the Indonesia Stock Exchange (IDX) during the 2023–2024 period. Data

were collected through the official IDX website (www.idx.co.id) and each company's published annual report.

The population consists of manufacturing companies listed on the IDX during the 2023–2024 period, comprising approximately 228 companies across the basic materials, industrials, and consumer (primary and non-primary) sectors under the IDX Industrial Classification (IDX-IC). The sample was selected using purposive sampling based on the following criteria: (1) the company is classified as a manufacturing company and continuously listed on the IDX throughout 2023–2024; (2) the company consistently published audited annual reports for the full period; and (3) the annual report and financial statements contain complete information necessary to calculate Human Capital Efficiency (HCE), Structural Capital Efficiency (SCE), Relational Capital Efficiency (RCE), and Return on Assets (ROA). Applying these criteria yielded a final sample of 70 companies with 140 firm-year observations (70 companies $\times$ 2 years), as summarized in Table 1.

Table 1. Sample selection procedure

Criteria	Firms	Firm-years
Manufacturing companies listed on the IDX, 2023–2024 (IDX-IC classification)	228	456
Less: companies not continuously listed, or with incomplete/unaudited annual reports	(71)	(142)
Less: companies with insufficient data to compute HCE, SCE, RCE, or ROA	(87)	(174)
Final sample	70	140

Variable measurement

The independent variables, human capital, structural capital, and relational capital — are measured following the Modified Value Added Intellectual Coefficient (M-VAIC) framework proposed by Ulu et al. (2014) and subsequently adopted by Ge and Xu (2021). The dependent variable, firm performance, is proxied by Return on Assets (ROA). Table 2 summarizes the operational definitions and measurement formulas for all four variables.

Table 2. Variable measurement

Variable	Measurement	Data Source
Human Capital (X1)	$HCE = VA / HC$	Annual report and financial statements
Structural Capital (X2)	$SCE = SC / VA$	Annual report and financial statements
Relational Capital (X3)	$RCE = RC / VA$ (RC = marketing expenses)	Annual report and financial statements
Firm Performance (Y)	$ROA = \text{Net Income} / \text{Total Assets}$	Financial statements

Where VA (Value Added) = Output – Input; HC (Human Capital) = total salary and wages expenses; SC (Structural Capital) = VA – HC; and RC (Relational Capital) is proxied by marketing expenses, following the operationalization used in prior M-VAIC-based studies of externally oriented intangible resources (e.g., Fuad & Nustini, 2022).

Data were analyzed using multiple linear regression with the model:

$$ROA = \alpha + \beta_1 HCE + \beta_2 SCE + \beta_3 RCE + \varepsilon$$

Prior to hypothesis testing, four classical assumption tests were conducted using the following a priori criteria: (1) normality, assessed with the Kolmogorov-Smirnov test, with residuals considered normally distributed if the significance value exceeds 0.05; (2) multicollinearity, assessed via Tolerance and Variance Inflation Factor (VIF), with the absence of multicollinearity indicated by Tolerance > 0.10 and VIF < 10; (3) heteroscedasticity, assessed with the Glejser test, with homoscedasticity indicated by a significance value above 0.05 for each independent variable; and (4) autocorrelation, assessed with the Durbin-Watson statistic, with values approaching 2 (and falling between the upper critical bound dU and 4 – dU) indicating the absence of autocorrelation. Hypothesis testing was then conducted using the t-test (partial effect of each independent variable), the F-test (simultaneous effect of all independent variables), and the coefficient of

determination (R^2 and Adjusted R^2) to assess the model's overall explanatory power, all evaluated at a two-tailed significance level of 5%.

Results and discussion

Descriptive statistics

Table 3 presents the descriptive statistics for all variables based on 140 firm-year observations.

Table 3. Descriptive statistics

	ROA	Human Capital	Structural Capital	Relational Capital
N	140	140	140	140
Mean	0.1948	1.3990	0.6268	0.6924
Median	0.185425	1.468229	0.524348	0.475127
Std. Deviation	0.26803	1.07592	0.97977	0.71086
Minimum	-0.49	-2.68	-2.82	-2.07
Maximum	2.98	2.72	2.92	0.83

Human Capital (X1) has a mean of 1.3990 with a standard deviation of 1.07592, indicating relatively heterogeneous data. Structural capital (X2) has a mean of 0.6268 with a standard deviation of 0.97977, also indicating heterogeneity. Relational Capital (X3) has a mean of 0.6924 with a standard deviation of 0.71086, indicating relatively more homogeneous data. Firm performance (Y), proxied by ROA, has a mean of 0.1948 with a standard deviation of 0.26803.

Classical assumption tests

Table 4 summarizes the four classical assumption tests. The Kolmogorov–Smirnov statistic of 0.074 (Sig. = 0.065 > 0.05) indicates that the regression residuals are normally distributed. For all three independent variables, Tolerance values exceed 0.10 and VIF values are below 10, confirming the absence of multicollinearity, while the Glejser test produces significance values above 0.05

(0.715, 0.303, and 0.871), indicating homoscedasticity. The Durbin–Watson statistic of 1.908 lies close to 2 and within the acceptable range (between dU and 4 – dU at $n = 140$, $k = 3$), indicating no autocorrelation. With all four assumptions satisfied, the regression model is appropriate for hypothesis testing.

Table 4. Classical assumption test results

Variable	Tolerance	VIF	Glejser (Sig.)
Human Capital	0.902	1.109	0.715
Structural Capital	0.999	1.001	0.303
Relational Capital	0.902	1.109	0.871

Notes: Normality (Kolmogorov–Smirnov) = 0.074 (Sig. = 0.065). Durbin–Watson = 1.908 ($n = 140$, $k = 3$). Criteria: Tolerance > 0.10; VIF < 10; Glejser Sig. > 0.05; residuals are normal if K–S Sig. > 0.05. All criteria are met.

Regression analysis and hypothesis testing

Table 5 reports the multiple linear regression results, including the coefficients, the model summary, and the F-test. The classical-assumption checks above confirm that the model is suitable for estimation.

Table 5. Multiple regression results (dependent variable: ROA)

Variable	B	Std. Error	Beta	t	Sig.
(Constant)	0.086	0.041	—	2.095	0.038
Human Capital (X1)	0.012	0.021	0.047	0.551	0.583
Structural Capital (X2)	0.052	0.022	0.191	2.337	0.021
Relational Capital (X3)	0.087	0.032	0.230	2.675	0.008

Notes: $R = 0.309$; $R^2 = 0.095$; Adjusted $R^2 = 0.076$; Std. Error of the Estimate = 0.258; $F = 4.786$ (Sig. = 0.003); $n = 140$. Significance evaluated at the 5% level (two-tailed).

Based on Table 5, the fitted regression equation is:

$$\text{ROA} = 0.086 + 0.012 \text{ HCE} + 0.052 \text{ SCE} + 0.087 \text{ RCE} + e$$

Human capital (X1) does not have a statistically significant effect on firm performance ($B = 0.012$, $Beta = 0.047$, $t = 0.551$, $p = 0.583 > 0.05$); H1 is not supported. Structural capital (X2) has a positive and significant effect on firm performance ($B = 0.052$, $Beta = 0.191$, $t = 2.337$, $p = 0.021 < 0.05$); H2 is supported. Relational capital (X3) has a positive and significant effect on firm performance ($B = 0.087$, $Beta = 0.230$, $t = 2.675$, $p = 0.008 < 0.05$); H3 is supported. Relational capital shows the largest standardized effect among the three predictors.

The F-test result ($F = 4.786$, $p = 0.003 < 0.05$) confirms that human capital, structural capital, and relational capital jointly have a statistically significant effect on firm performance, indicating that the overall regression model is appropriately specified. This is a separate, complementary finding to the individual (partial) significance of each predictor established by the t-tests above, rather than an indication that the combined effect is quantitatively "stronger" than the sum of the individual effects. The model explains 9.5% of the variation in ROA (Adjusted $R^2 = 0.076$), indicating that most of the variation in firm performance is attributable to factors outside the three intellectual-capital components examined here, a point taken up further in the Limitations.

Discussion

Human Capital and Firm Performance

Human capital does not have a significant effect on firm performance in manufacturing companies listed on the IDX during 2023–2024 ($Beta = 0.047$, $p = 0.583$). This finding indicates that the efficiency of human capital, as measured by HCE, has not been able to significantly improve ROA over this period. A plausible explanation specific to the short, two-year observation window is that returns on employee competency investment — training, education, and skill development, typically materialize with a lag, so a two-year window may be too short to capture their financial payoff; this is a methodological, not merely substantive, limitation, since a longer panel could plausibly detect a delayed effect that this design cannot.

From the perspective of Resource-Based Theory, human capital is categorized as a strategic resource capable of creating sustainable competitive advantage

when effectively managed. The non-significant result suggests that manufacturing companies in the sample have not yet fully converted employee competencies into superior financial performance, possibly because performance is also shaped by operational efficiency, technology utilization, market conditions, and managerial policy, factors not captured by the present model.

This finding is consistent with Ali et al. (2022) and Indriyana and Munawaroh (2024), who similarly found that human capital does not always have a significant impact on firm performance, but differs from Farhanah and Susilawati (2022) and Thaib et al. (2022), who reported a positive and significant effect of human capital on financial performance. Beyond generic references to "industry characteristics," a more specific explanation is that Farhanah and Susilawati (2022) and Thaib et al. (2022) examined different industry contexts and used longer or differently structured observation windows, which may have allowed lagged human-capital returns to surface, whereas the present study's single, recent two-year window may not.

Structural Capital and Firm Performance

Structural capital has a positive and significant effect on firm performance (Beta = 0.191, $p = 0.021$), indicating that stronger organizational systems, procedures, databases, and internal control mechanisms are associated with higher ROA in this sample. Companies with more developed structural capital are better positioned to manage knowledge, coordinate business activities, and utilize assets efficiently, which in turn supports profitability.

According to Resource-Based Theory, structural capital is a valuable organizational resource because it enables the transformation of individual knowledge into organizational capability. Manufacturing firms, in particular, depend heavily on standardized production systems, quality-control procedures, and supply-chain-coordination technology; the significant result here is consistent with the idea that well-developed operational infrastructure translates relatively directly into cost efficiency and asset utilization in this sector, more so than in service-oriented sectors where structural capital may operate through less direct channels.

These results are consistent with Skhvediani et al. (2023) and Indriyana and Munawaroh (2024), both of whom found that structural capital positively affects firm performance in manufacturing settings, reinforcing that organizational infrastructure and information systems are a comparatively reliable driver of performance in this sector.

Relational Capital and Firm Performance

Relational capital has a positive and significant effect on firm performance (Beta = 0.230, $p = 0.008$), the largest standardized effect among the three predictors. This indicates that stronger relationships with external stakeholders, customers, suppliers, investors, and business partners, are associated with improved firm performance in this sample.

Strong relational capital can enhance customer loyalty, facilitate access to market information, improve supply-chain efficiency, and strengthen reputation, thereby supporting operational performance and profitability. From the Resource-Based Theory perspective — complemented by a stakeholder-oriented view, as noted in Section 2.3 — relational capital is a strategic resource because it is built through long-term interactions based on trust and cooperation, which are difficult for competitors to replicate. That relational capital shows the largest effect size in this manufacturing sample is plausibly linked to the sector's reliance on multi-tier supplier networks and distribution relationships, where relational quality has a comparatively direct bearing on production continuity and sales.

This finding supports Fuad and Nustini (2022) and Besir and Yuyetta (2023), who reported a positive and significant relationship between relational capital and firm performance, and is consistent with Nurseha et al. (2024). The result indicates that manufacturing companies in this sample benefit substantially from strong external networks and stakeholder relationships, positioning relational capital as an important driver of financial performance alongside structural capital.

Conclusion

This study examined the effect of human capital, structural capital, and relational capital on firm performance in manufacturing companies listed on the

Indonesia Stock Exchange during 2023–2024. The results show that human capital does not have a significant effect on firm performance (Beta = 0.047, $p = 0.583$), whereas structural capital (Beta = 0.191, $p = 0.021$) and relational capital (Beta = 0.230, $p = 0.008$) both have a positive and significant effect. Jointly, the three components explain 9.5% of the variation in ROA (Adjusted $R^2 = 0.076$; $F = 4.786$, $p = 0.003$).

These findings extend Resource-Based Theory by showing that, within a single manufacturing-sector sample and a short two-year window, not all components of intellectual capital function equally as sources of sustainable competitive advantage: internally developed structural systems and externally oriented relational resources are more consistently associated with financial performance than human capital alone. This qualifies a common assumption in the intellectual capital literature, that all three M-VAIC components contribute uniformly to firm value, and instead suggests that the RBT prediction for human capital may require a longer time horizon, or complementary firm-specific conditions, to materialize as measurable financial performance. It also lends empirical support to strengthening the theoretical treatment of relational capital with a stakeholder-oriented perspective given its comparatively large observed effect.

For company management, the results suggest prioritizing investment in organizational systems (structural capital) and stakeholder relationships (relational capital) as strategic resources with a demonstrated, statistically significant link to profitability within this sample. This does not imply that human capital investment should be deprioritized; rather, because its financial return did not register as significant within a two-year window, management should treat human capital development as a longer-horizon investment, evaluated on multi-year rather than single-cycle performance metrics. For investors and analysts, the findings suggest that a company's organizational infrastructure and stakeholder-relationship quality may be more immediately informative signals of near-term financial performance in the manufacturing sector than reported measures of workforce competency alone.

This study has several limitations, each paired with a corresponding direction for future research. First, the model's explanatory power is modest (Adjusted $R^2 = 0.076$), indicating that most of the variation in ROA is explained by factors

outside the three intellectual-capital components examined; future studies could incorporate additional predictors such as firm size, leverage, or corporate governance characteristics. Second, firm performance is measured solely through an accounting-based proxy (ROA); future research could complement this with market-based measures such as Tobin's Q or Price-to-Book Value to assess whether intellectual capital is similarly valued by capital markets. Third, the cross-sectional regression design cannot rule out endogeneity or reverse causality, for instance, more profitable firms may simply have greater resources available to invest in structural and relational capital; future studies could address this using lagged predictors, panel fixed-effects models, or an instrumental-variable/GMM approach. Fourth, the two-year observation window (2023–2024) is relatively short for capturing the delayed returns that intellectual-capital investments, particularly in human capital, often generate; extending the panel to five or more years would allow a more robust test of lagged effects. Finally, the sample is restricted to a single sector (manufacturing) and a single country (Indonesia); future research could examine other sectors or adopt a cross-country comparative design to assess the generalizability of these findings.

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